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Resource Study Puts Concrete On Solid Ground

Extracting any raw material from the land takes a toll on the environment. But extracting the raw materials for concrete has a lower impact than that of other construction materials.

These impacts were measured and compared in a comprehensive study sponsored by Natural Resources Canada and conducted by the Canadian wood industry's research arm, Forintek. The study rates the effects of resource extraction for concrete, wood, and steel.

Forintek's study compares logging for wood products, iron ore mining for steel production, limestone quarrying for cement-making, and aggregate quarrying for concrete.* The disruption to the land resulting from these operations—termed ecological carrying capacity effects—is "at least as important, if not more important, than other more readily measured environmental impacts."[1]

The impact of concrete and cement materials extraction is less than that of other construction materials because limestone and aggregate quarries are easily reused. Their disruption to the environment can be intense, but closely contained and temporary. In as little as one or two years after closing, quarries can be restored to agriculture, nature reserves, parks, and many other uses. In San Antonio, Texas, for example, aggregate quarries have been transformed into a golf course, amusement park, outdoor theater, city zoo and Japanese gardens.

Resource depletion is not an issue for cement and concrete. Limestone, the key ingredient of cement, is one of the most common and abundant materials on earth. Aggregates are also plentiful: Sand and gravel are produced commercially in every U.S. state, and crushed stone is produced in every state except Delaware.

Recycling also plays a role in ecological carrying capacity. Cement plants supplement virgin materials with industrial byproducts such as fly ash from coal-fired boilers and mill-scale and foundry sand from the iron and steel industries. Concrete producers incorporate fly ash and slag in mixes. And concrete itself can be recycled as aggregate for new concrete.

Concludes Forintek:

"We will not 'run out' of limestone, gypsum, aggregates, sand, or any of the other ingredients in concrete for a very long time, centuries or more. The supply of most ingredients is, for all intents and purposes, inexhaustible."[2]

Other materials have less flexibility in both how and where their raw materials are extracted. Production of steel products relies on iron ore as its principal raw material. And unlike limestone and aggregate quarries, says Forintek, "iron ore extraction often involves very deep pits which are rarely restored. Duration ... of an iron mine may be forever."[2]

*Limestone is the principal ingredient of cement, the binding agent of concrete. Cement makes up 10% to 15%, by weight, of the concrete mix. The remaining ingredients are about 25% sand (fine aggregate), 40% gravel or crushed stone (coarse aggregate), and water.

But the Forintek report concludes that the ecological impacts associated with extraction are the greatest for wood:

"The ecological impacts associated with the extraction of wood as a resource are more extensive than the ecological impacts associated with other materials considered in this study. This is in part because forests provide many ecological and physical functions including pollution absorption, climate regulation, soil production, watershed protection, carbon recycling, wildlife habitat, and human receational activity. "[2]

The Forintek report concludes by ranking each building material's impact based on extensiveness, intensity, duration and site significance. From these rankings, an impact index was established for each material.

Extent measures quantity—the amount of land disrupted by extraction. Intensity gauges the degree of disruption. Duration is the length of time before the disrupted area returns to normal, if ever. Significance refers to the importance of the disruption—the beauty of the site and its ecological richness.

The accompanying table summarizes the results. In general, the mining and quarrying operations for concrete materials and iron ore result in an intense, but not extensive, disruption to the land. That is, the disruption is complete—land is removed—but the amount of land disrupted is relatively small.

The significance of the land affected is also low. Quarries and mines can be placed at sites that are neither ecologically rich nor important.

Logging has a higher impact in every category except intensity. The amount of land disrupted per unit of building material is high. Although forests may be replanted, the duration of the disruption is complex and variable. Even if geniune renewal to their previous state is possible, the process is measured in generations rather than years. Likewise, the significance of logging's disruption is rated very high—forests are a national treasure.

Although the Forintek report cautions that these ratings are illustrative only, they clearly show concrete's benefits as a resource-efficient, sustainable construction material.

Weighing the environmental impact of resource extraction

	Extent	Intensity	Duration	Significance
Concrete Ingredients	low to moderate	moderate to high	moderate	low
Iron ore	very low to low	high	high	very low
Wood	high to very high	moderate	variable, complex	very high (some sites)

Cutting coastal forests hurts the land 3.25 times more than mining concrete's aggregate[1]

		Impact Index
Concrete	Aggregates Extraction	1.00
	Limestone Quarrying	1.50
Steel	Iron Ore Mining	2.25
Wood	Boreal Timber Harvesting	2.50
	Coastal Timber Harvesting	3.25

References

1. *Assessing the Relative Ecological Carrying Capacity Impacts of Resource Extraction,* by Wayne B. Trusty & Associates Ltd. in association with Environmental Policy Research, submitted to Forintek Canada Corp. for its Sustainable Materials Project, August 1994.

2. *Ecological Carrying Capacity Effects of Building Materials Extraction,* by Dr. Robert Paehlke, Natural Resources Canada, submitted to Forintek Canada Corp. for its Sustainable Materials Project, Sept. 1993.